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Seasonal Dairying: Will the Adoption of a National Program Enhance Income to Ohio Dairy Producers?

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The Ohio State University
Department of Agricultural Economics and Rural Sociology

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Executive Summary[1]

Milk prices in the United States and Ohio follow a typical seasonal pattern of being high in the fall and winter months and lower than average in the spring and summer months. Milk production follows just the opposite pattern. This suggests the idea that if a dairy producer could adjust the timing of production, i.e., seasonal dairying, to match the price peaks and troughs, revenue to the dairy could be increased.

Research on the economics of this alternative generally concludes that on an individual dairy farm basis seasonal dairying to capture price swings would enhance gross and net farm income. If this works for an individual then could it possibly be a way to enhance income to a larger group of dairy producers? The answer to this question is generally no. While an individual can treat the price pattern as fixed and not at all influenced by his or her decisions, the market cannot take this position. Shifts in production of sufficient magnitude as to raise the revenue levels of all Ohio dairy producers will modify the market price pattern in such a manner as to negate any revenue enhancement opportunity.

Does this mean that seasonal dairying should be discarded as a revenue enhancing tool for Ohio's dairymen? Certainly not. While the opportunity to provide increased returns to all dairy producers is not there, the opportunity for some producers is very real.

As a final point it is clear that some adjustment of milk production to more nearly match market demands would increase to revenues to all dairy producers. To the extent that resources are utilized to balance the current contra-seasonal pattern of production and demand, those resources would be released to be paid to the production sector under a more balanced production and demand situation.

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[1]. The authors express their appreciation to Gary Schnitkey and Dean Baldwin for their helpful comments and suggestions on this paper. Any errors or omissions remain the sole responsibility of the authors.

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Introduction

Income or revenue to a dairy producer from the sale of milk is influenced by cost of production and market price factors. On the cost of production side there are fixed expenses for capital equipment and variable expenses for feed, labor, fuel, etc.. On the revenue side, the money that a dairy producer receives is influenced fundamentally by the strength of market demand relative to market supply of milk.

The revenue for any given period of time, such as a month, is the product of the market milk price and the amount of milk the dairy producer has available for sale. While the producer exercises managerial control over production levels and input costs, the same control does not exist for market milk prices. The individual dairy producer is a *price taker* in the market. By viewing the market price pattern as fixed to a given dairy producer it might be possible to increase gross revenue by shifting the milk production pattern to take advantage of the market price highs and lows. Inherent in this strategy is the assumption that a single or small group of producers may shift production without impacting the market price pattern. Should a large share of production be shifted this assumption becomes more questionable. A significant shift in a local milkshed may alter the market price pattern to such a

degree that no pricing advantage remains.

Study Objectives

The objective of this study is to investigate the sensitivity of the uniform milk market price in Ohio under alternative assumptions about the seasonal milk production pattern in Ohio. This investigation will use a computer model of the United States dairy industry to measure this sensitivity. Inherent to this model is the typical seasonal production pattern evident in the United States over the past thirty years. This seasonal pattern will be modified to reflect alternative production patterns for Ohio, and the behavior of milk prices will be simulated. From this the impact on revenues to Ohio dairy producers can be measured. A couple of caveats are in order. First, the computer model is just that, a model. The impacts calculated from the model are representative and would not reflect the exact situation for an actual dairy producer. Second, a critical assumption to the model results is that cost of production is at least no higher under differing seasonal production patterns. The model is designed to reflect the interaction of market supply, demand, and price but does not incorporate production cost.

The paper is organized in the following manner. First the general seasonal pattern of milk production and milk prices are presented. This pattern is shown for the United States and for Ohio. Second, the general notion of seasonal dairying is presented. Third, a brief overview of the economics of milk production and demand is developed as this pertains to seasonality in milk prices. This material is present in the context of the computer simulation and analysis model. Fourth, alternative

seasonal production patterns are derived and the impact on local and national milk prices, consumption, and farm revenue are measured. Conclusions and implications are presented in the final section.

Seasonality in Milk Markets

In the United States, the behavior of milk prices over a given marketing year is determined by the relative balance of available supplies and the strength of commercial demand. Available supply in a specific month is determined primarily by production level in that month. Over a typical marketing year production is a its peak in the spring period in May and June, and at its low point in the late fall, November and December, Figure 1. This seasonal pattern is evident in the seasonal index (SI) of U.S. milk production calculated from monthly production levels over the period 1980 through 1990.[1] In the U.S. milk production is at its low points in February and November, averaging only slightly more that 93 percent of the average monthly production. The peak occurs in May as is clearly evident by the SI reaching 108 percent of average.

This typical seasonal swing in production relative to demand produces a opposite and equally pronounce seasonal pattern in U.S. milk prices. The SI's for the U.S. All Wholesale Milk Price, and the Manufacturing Milk Price are presented in Figures 2 and 3. Milk prices decline in the early spring reaching a low of 96

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[1] The seasonal index (SI) provides a measure of average production in each month relative to the average for the year. These relative levels are calculated after the effects of trend in the series have been removed.

U.S. Milk Production
Estimated Seasonal Components

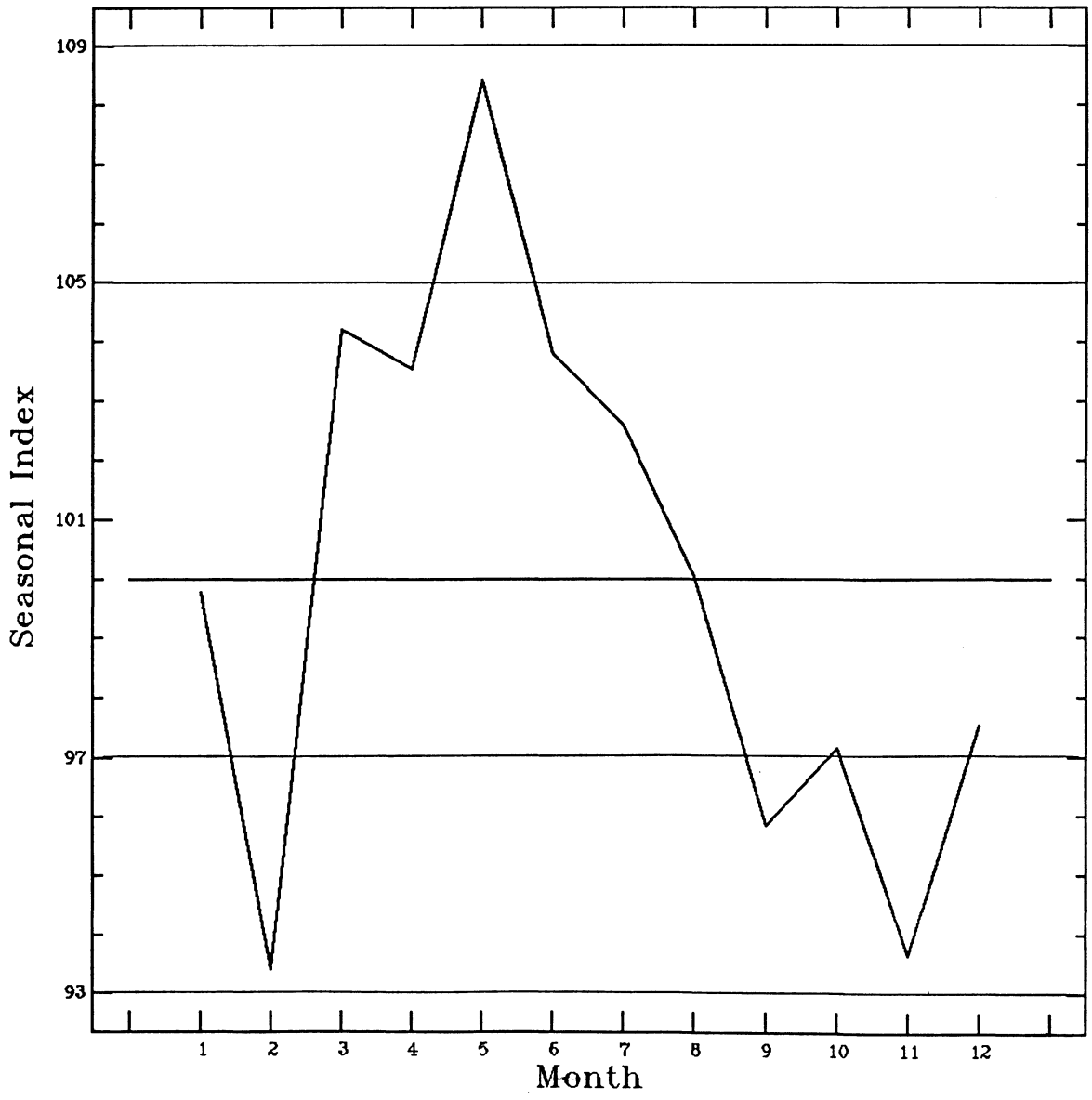

Figure 1

U.S. All Milk Price
Estimated Seasonal Components

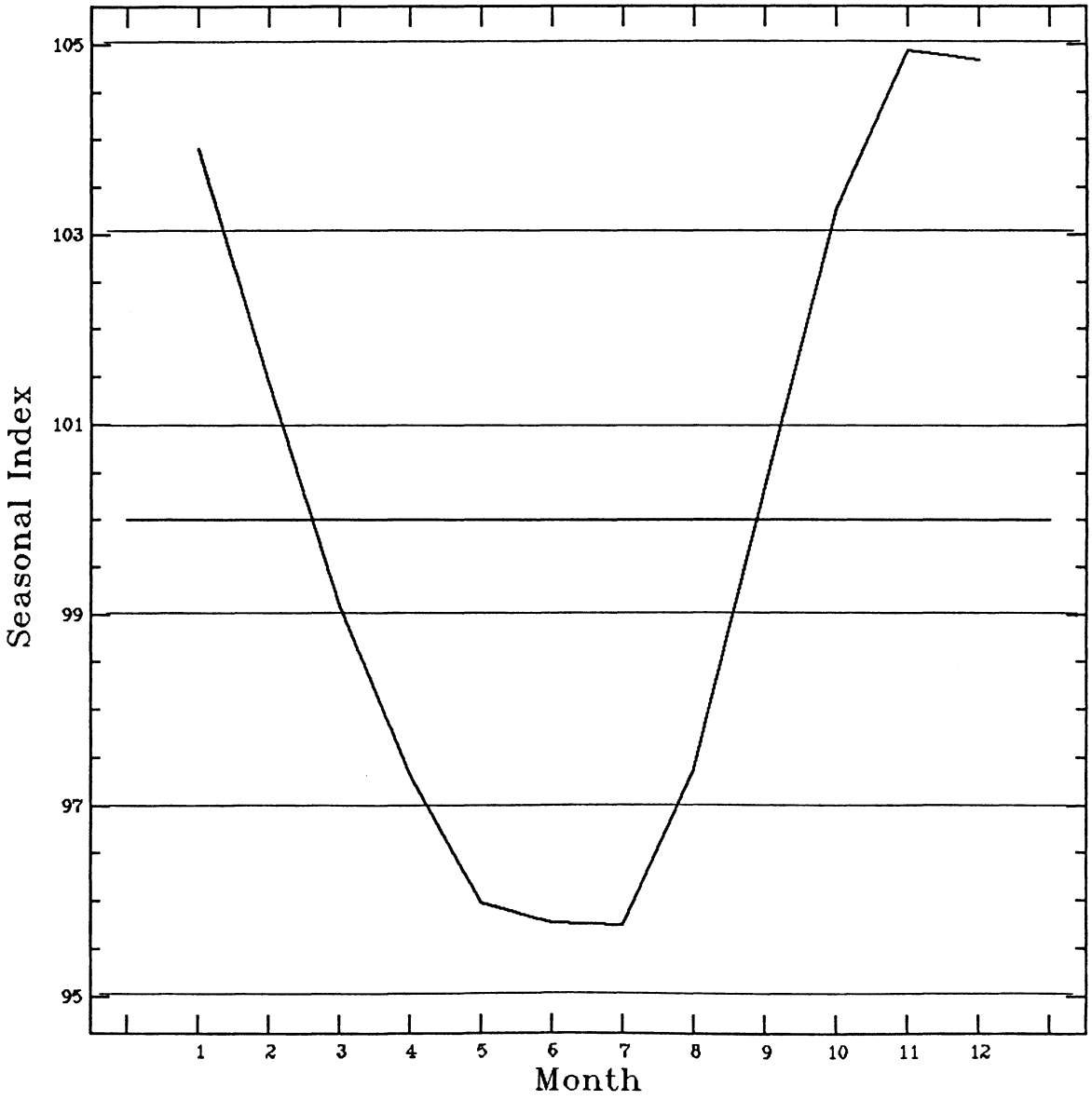

Figure 2

U.S. Manufacturing Milk Price
Estimated Seasonal Components

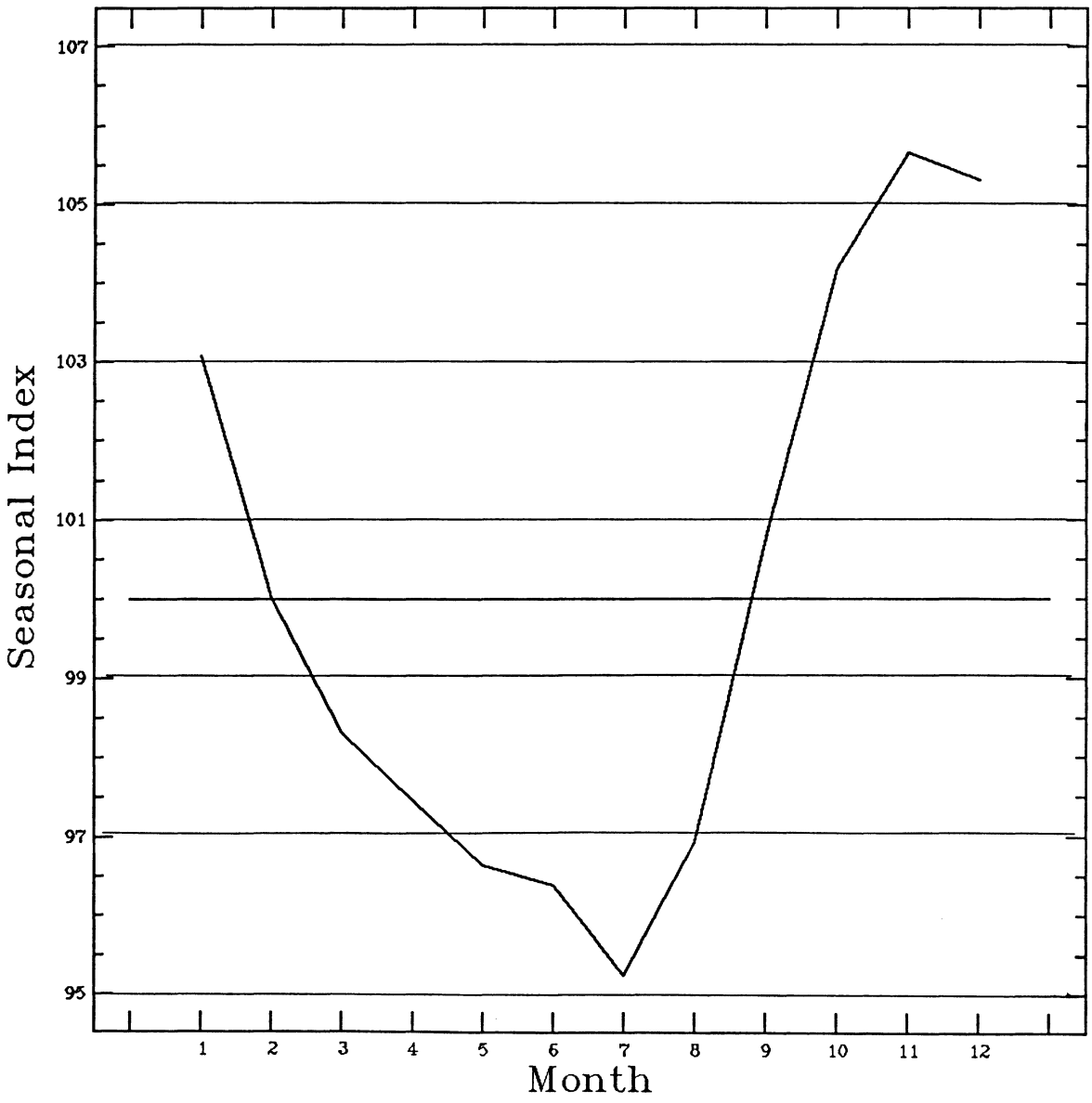

Figure 3

percent of average in the May through July months and then increasing in the late summer and fall months.

Seasonality in Ohio Milk Production

This same seasonal pattern is evident for Ohio dairying. Figure 4 depicts the seasonal pattern in Ohio milk production which has prevailed over the last eleven years, 1980 through 1990.[2] The seasonal index shown in that figure measures the recurring seasonal pattern for each month of the marketing year. The May seasonal peak for Ohio is very pronounced. May production reaches 111 percent of the seasonal average at that time. The seasonal low occurs in November when production is under 93 percent of average.

Seasonality Ohio Commercial Fluid Milk Demand

Seasonal demand for fluid milk is determined by a number of factors of which the time of the year is important. The SI for total fluid sales is presented in Figure 5. Commercial demand for milk and milk products is typically at its peak in the fall and winter months and at its low point during the summer months. The high points for fluid demand occur from October through March. The low point for fluid demand occurs in June of each year.

Seasonality in Ohio Uniform Milk Prices

The typical pattern for milk prices is determined by this supply-demand

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[2] The data for this study are the reported combined deliveries, sales, and prices for the Federal Milk Marketing Orders 33 and 36 which cover the majority of milk production and disposition in Ohio.

OHIO FMMO 33/36 RECEIPTS
Estimated Seasonal Components

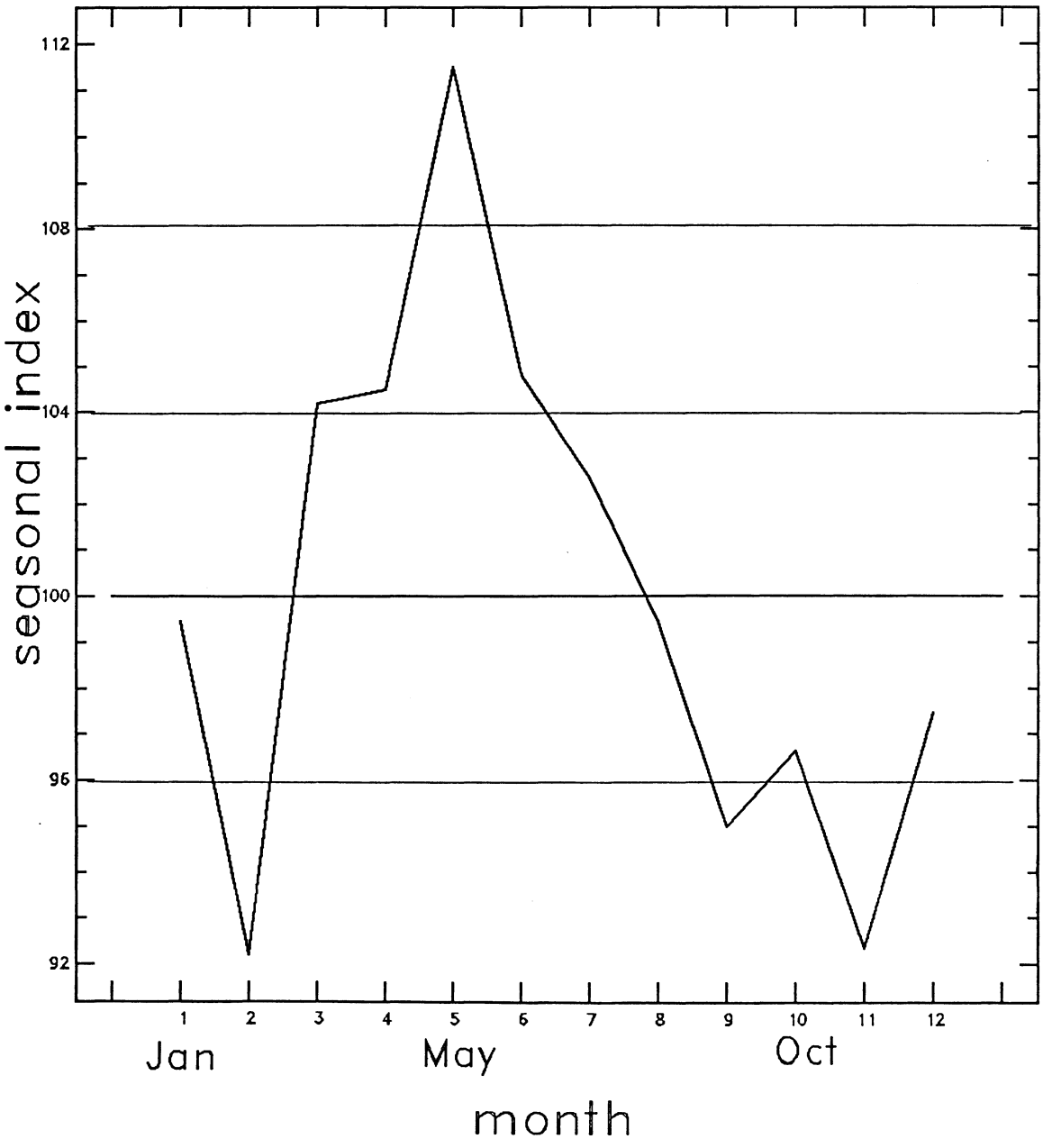

Figure 4

interaction. With milk production peaking in the May and June period and commercial demand declining at that time, milk prices follow a season pattern of being at their low point in June and peaking in November. This seasonal pattern is shown for the Ohio Federal Order 33/36 uniform milk price in figure 6. The seasonal pattern is very striking. Milk prices paid to dairy farmers are above the normal seasonal average for the months of September through February, and are below the seasonal average for the April through August period.

Seasonal Dairying: An Opportunity for Increased Revenues?

The idea behind seasonal dairying can best be described by first considering the calving interval and lactation curve of a single typical dairy cow. The typical calving interval on U.S. dairy farms is 13 to 13.5 months. With this length of calving interval a given proportion of the dairy herd is beginning the lactation process each month, while another proportion of the animals in the herd are at some point on the lactation curve. This leads to a monthly milk production curve for the entire herd which is difficult to synchronize to market price patterns.

In a seasonal herd situation the calving interval must be managed so that all dairy cows calve at 12 month intervals and dry off at the same time (Zartman). With this management strategy, the dairy can select the month for calving for the entire herd. This management strategy results in a synchronized seasonal lactation pattern for the entire herd which can be synchronized to market price patterns.

Changing from a herd management strategy which uses a 13 to 13.5 month calving interval to one with a 12 month interval requires a commitment of

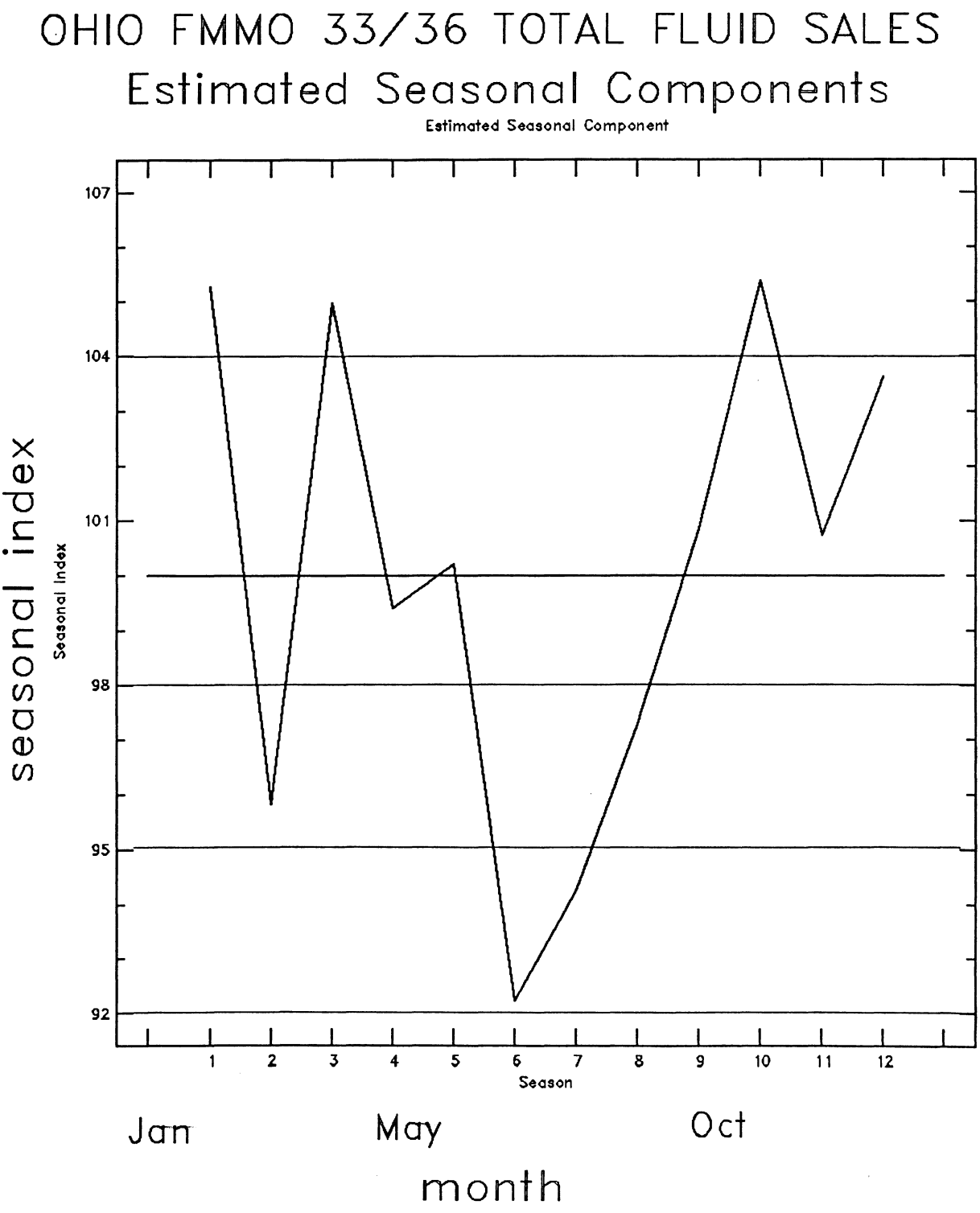
OHIO FMMO 33/36 TOTAL FLUID SALES
Estimated Seasonal Components
Estimated Seasonal Component
seasonal index
Seasonal Index
107
104
101
98
95
92
1
2
3
4
5
6
7
8
9
10
11
12
Season
Jan
May
Oct
month

Figure 5

approximately four years to complete (Zartman). Once the calving interval is synchronized at 12 months with the dairy herd beginning the lactation process in the same month the dairy can be managed as a seasonal dairy with 9 or 10 months of milk production and 3 or 2 months in which all of the dairy cows are dry.

The contra-seasonal behavior of milk production and market price appears to offer an opportunity for increases in milk revenue to the individual dairy producer. The dairy producer who follows a herd freshening management strategy that produces the most milk in the May or June period and the least milk in the November and December period will receive milk revenues dictated by high production-low price and low production-high milk price patterns. This pattern for two consecutive marketing years is illustrated dramatically in figure 7. In this figure the seasonal production pattern for the Ohio 'market' is arrayed against the seasonal market price pattern.[3] The existing market production pattern can be identified by calculating the average proportion of milk produced each month relative to the total average production for the period. These monthly percentages were calculated for total milk receipts in Federal Milk Orders 33 and 36 over the period 1980 through 1990.

Market vs. Seasonal Production Pattern

A typical dairy which produces milk in all twelve months of the year is not in

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[3] The seasonal 'market' production pattern is measured by the percent of average total milk production being delivery during each month to Federal Order plants over the period 1980-90.

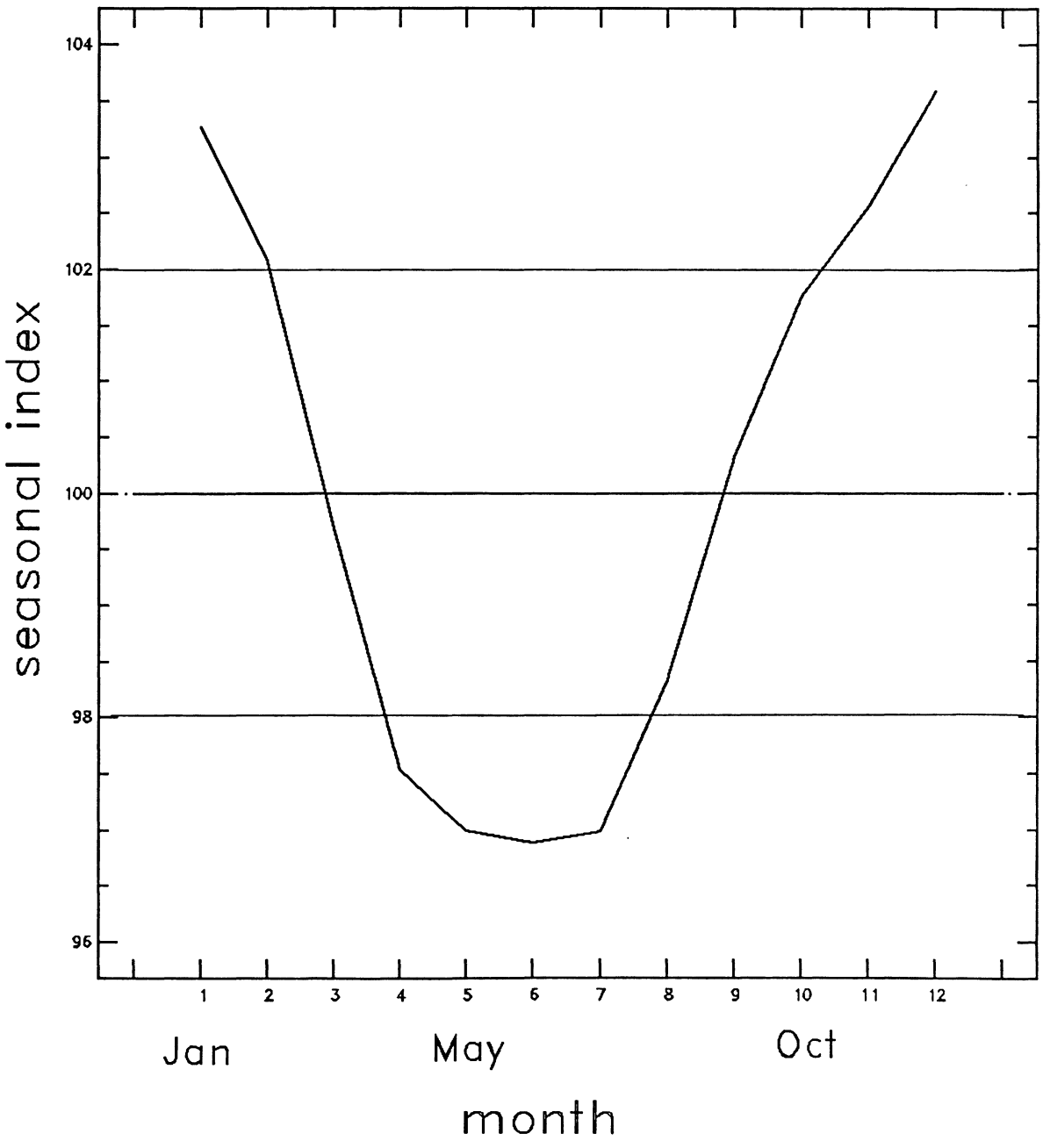
OHIO FMMO 33/36 UNIFORM MILK PRICE
Estimated Seasonal Components
seasonal index
104
102
100
98
96
1
2
3
4
5
6
7
8
9
10
11
12
Jan
May
Oct
month

Figure 6

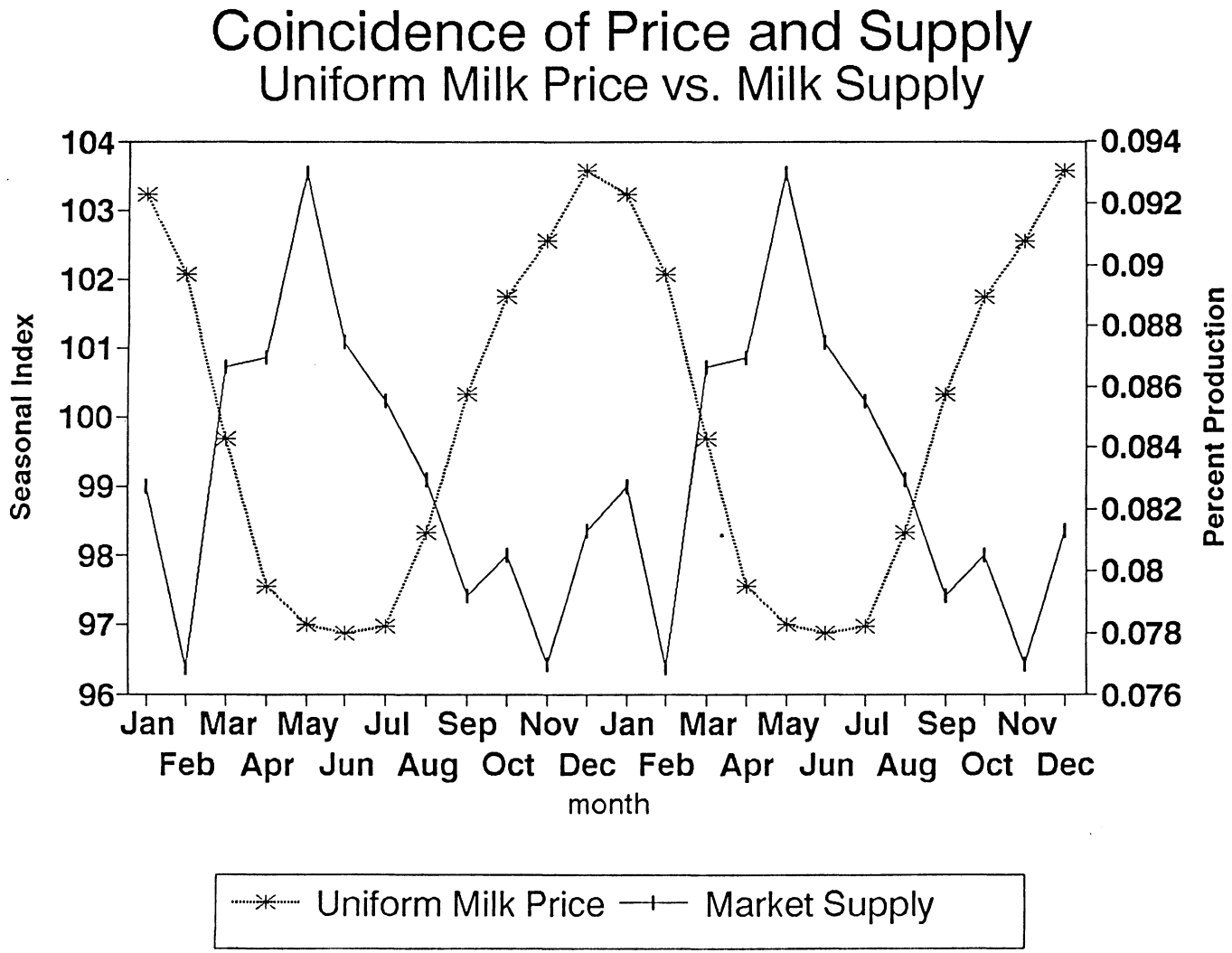
Coincidence of Price and Supply
Uniform Milk Price vs. Milk Supply
Seasonal Index
104
103
102
101
100
99
98
97
96
Percent Production
0.094
0.092
0.09
0.088
0.086
0.084
0.082
0.08
0.078
0.076
Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov
Feb Apr Jun Aug Oct Dec Feb Apr Jun Aug Oct Dec
month
Uniform Milk Price
Market Supply

Figure 7

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by

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a position to manage its milk production pattern to take advantage of this marked price pattern. A dairy which is organized around a 12 month calving interval can select the beginning lactation month in such a manner that the largest share of the farm's milk production coincides with the peak in milk prices. This type of seasonal milk production pattern can, for a single dairy farm increase the gross revenue from the sale of milk. A typical seasonal pattern commencing in October and ending lactation June, with the months of July, August and September dry, is depicted in Figure 8.[4]

Market Implications of Seasonal Dairying

A question arises as to the effect that this shift in management strategy will have on market milk price patterns as an ever increasing proportion of the milk supply in a given milkshed is timed to a counter-seasonal pattern. As more milk is produced in the fall/winter months and less in the spring/summer, the imbalance of production and demand will not be as great. The seasonal peaks in market price will be less and so will the potential for increases revenues.

The Market Economics of Seasonal Dairying

A computer dairy market simulation model (DAISI) was developed to assess the impact that a shifting seasonal pattern in Ohio on milk prices in the Ohio

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[4] The seasonal production curve illustrated here is derived from the herd lactation curve actually achieved for Holsteins on the Mahoning Dairy Project in Ohio during 1990. The lactation curve in the Mahoning Dairy project was achieved with a March freshening herd. This lactation pattern has been shifted to October as the initial month of milk production.

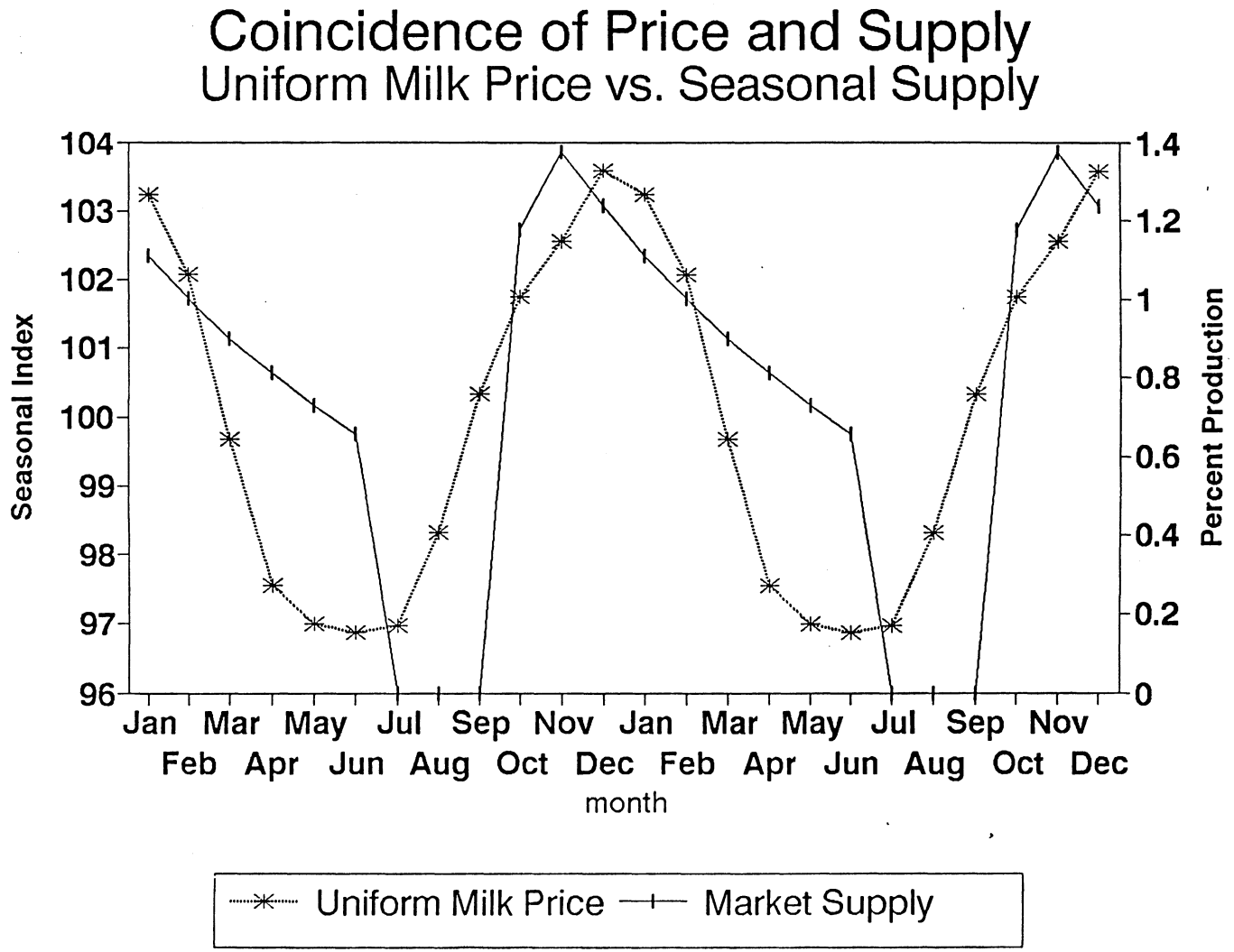
Coincidence of Price and Supply
Uniform Milk Price vs. Seasonal Supply
Seasonal Index
104
103
102
101
100
99
98
97
96
Percent Production
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan Mar May Jul Sep Nov Jan Mar May Jul Sep Nov
Feb Apr Jun Aug Oct Dec Feb Apr Jun Aug Oct Dec
month
Uniform Milk Price
Market Supply

Figure 8

milkshed. The computer model simulates the supply and demand balance and accompanying market price patterns for the U.S. dairy sector. The model contains nine production and demand regions along with a national market to balance the supply and demand for manufactured dairy products. Also incorporated into the computer model are the Federal Milk Marketing Order classified pricing provisions and the Federal support price purchase program. The question to be addressed by the computer simulation is if the production of Ohio shifted to a seasonal pattern, what effect would this have on the seasonal pattern of the uniform milk price in the Ohio market?

The Individual vs. the Market

When considering the revenue enhancement aspects of seasonal dairying on an individual level it is possible to take the impact on market prices as nonexistent. Changes in the production pattern on a single farm will not impact on market price. Therefore the important questions are centered on the issues of management and cost of inputs which will be changed with seasonal dairying.

At the market level this nonexistent impact on market price cannot hold true. As an ever increasing proportion of the market production shifts toward a seasonal pattern market price will react. The direction and magnitude of this reaction determines whether or not seasonal dairying can provide a means to enhance dairy revenues across the market.

Elasticity of Total Revenue

The general mechanism used by economists to answer questions relating

market price changes to market production changes is the concept of elasticity. The elasticity is a measure of the responsiveness of market price to production changes stated on a percent basis. In the present case, the elasticity of total revenue with respect to market production provides a starting point to address the issue of market wide seasonal dairying.

The *elasticity of total revenue* can be expresses as:

% Change in Total Revenue = 1 + % Change in Market Price,

with the percent change in market price being generated as a direct result of the change in market production. For the individual, the elasticity equals 1, changes in an individuals production will have no impact on market price. For the market, this is not the case. The percent change in market price will generally be equal to the reciprocal of the percent change in the quantity demanded with respect to a one percent change in market price. For most dairy markets this latter elasticity is normally estimated to be approximately -0.3. With this as an estimate, the elasticity of total revenue for the market is in the neighborhood of -2.33.

A 10 percent change in the level of market production will change market price in the opposite direction by -23.3 percent. Seasonal dairying at the market level which increases fall production by 10 percent will reduce market price at that time by -23.3 percent. Seasonal declines in market production occurring in the late spring and summer months will increase the market price by an equal percentage.

It becomes important to carefully account for the possibility of a market price change when considering the question of seasonal dairying as a general method to

improve or enhance dairy revenue to Ohio dairy producers. The ability to simultaneously account for all of the interactions between shifts in production, market demand and seasonal price patterns has been incorporated into a computer simulation model of the United States dairy industry (Thraen).[5]

This computer model is used to assess the long term impact of seasonal dairying on market prices and gross revenue in the Ohio dairying area. The results of this analysis are presented in Figures 9 and 10. Figure 9 shows the quarterly seasonal uniform milk price pattern which prevailed in the Ohio marketing area over the period 1986 through 1990. This pattern is consistent with the monthly seasonal pattern illustrated earlier. In the computer simulation, the milk production pattern of Ohio is shifted so as to represent a seventy five percent shift in milk production to an October or third quarter seasonal freshening pattern. The production in each quarter represents the proportion of total production which could be achieved with a seasonal dairy herd. Figure 10 illustrates the impact that a market wide shift such as this would have on the uniform milk price.

Examination of Figure 10 reveals the difficulty with seasonal dairying as a market approach to dairy revenue enhancement. The large shift in production to the fall quarter significantly alters the market price pattern. Where the fall quarter has been traditionally the high price period, Figure 9, it is now a lower price period. In fact the decline in milk price at this time of the year is sufficient to negate any

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[5] The computer model is described in general in Thraen, and will be only generally discussed in this paper.

OHIO UNIFORM MILK PRICE: QUARTERLY
Estimated Seasonal Components
Baseline Data

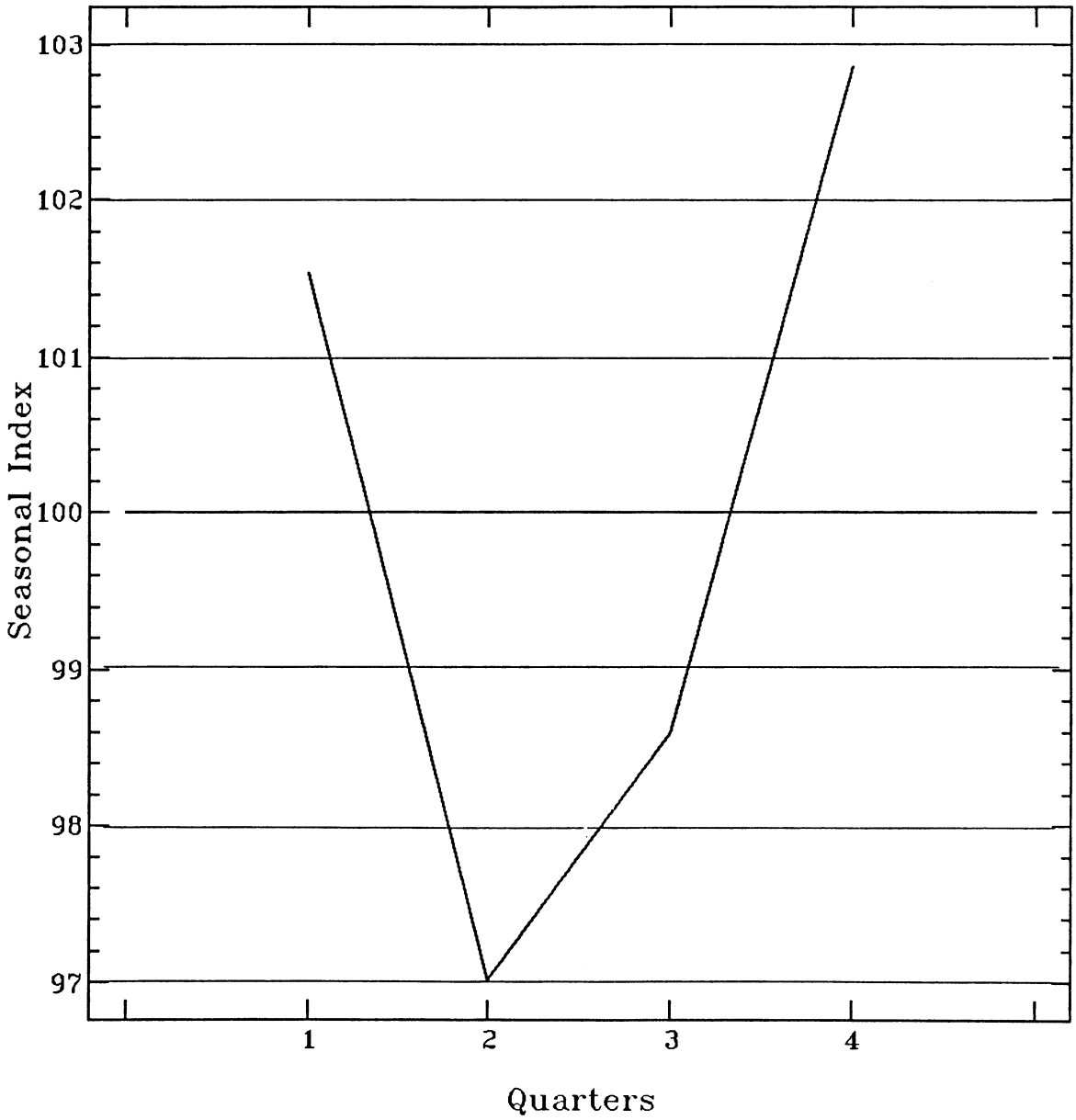

Figure 9

ESTIMATED OHIO UNIFORM MILK PRICE

Estimated Seasonal Dairying Pattern

reflects an October seasonal freshening

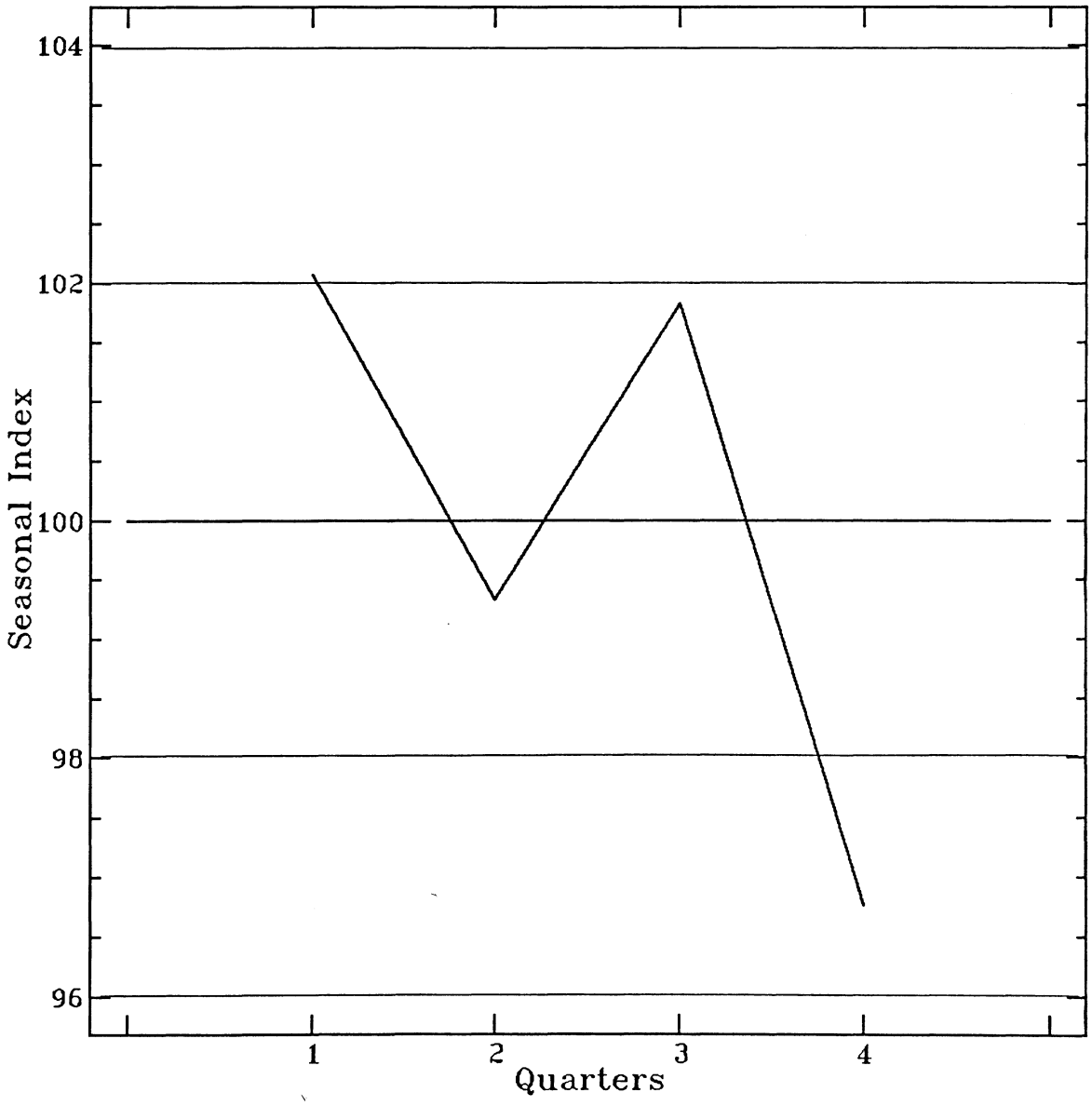

Figure 10

revenue gains occurring during the rest of the marketing year. It can be concluded that wide scale shifts in Ohio dairy production aimed at taking advantage of the higher seasonal prices will eliminate those traditional price patterns and result in no improvement in revenue to dairy producers as a group.

Conclusions

Milk prices in the United States and Ohio follow a typical seasonal pattern of being high in the fall and winter months and lower than average in the spring and summer months. Milk production follows just the opposite pattern. This suggests the idea that if a dairy producer could adjust the timing of production, i.e., seasonal dairying, to match the price peaks and troughs, revenue to the dairy could be increased.

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As a final point it is clear that some adjustment of milk production to more nearly match market demands would increase to revenues to all dairy producers. To the extent that resources are utilized to balance the current contra-seasonal pattern of production and demand, those resources would be released to be paid to the production sector under a more balanced production and demand situation.

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(3) Milligan, R.A.,"Optimal Production Schedules for a Representative Farm Under Alternative Seasonal Milk Pricing Patterns of Base-Excess Plan: A Comment", Journal of the Northeastern Agricultural Economics Council, November 1982.

(4) Oltenacu, P.A., H.R. Ainslie and J.F. Keown, "Projecting the Income from Milk Sales for a Dairy Enterprise", Journal of Dairy Science, Volume 59:1976.

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